

CLAIMS

1. A filtration apparatus comprising:

a filtration container for housing floating filter media forming a stratified filter layer;

a supply pipe for supplying a treatment liquid containing removables to the filtration container;

a discharge pipe for evacuating the treatment liquid which was subject to filtration, wherein

by generating a spiral flow in a lower side of the filter layer, a downward force which is stronger than a buoyant force exerted in the floating filter media is applied to the floating filter media constituting a bottom layer of the filter layer to separate the floating filter media constituting the bottom layer from the filter layer.

2. The filtration apparatus of claim 1, wherein the supply pipe is coupled to the filtration container at a position lower than a bottom surface of the filter layer.

3. The filtration apparatus of claim 1, further comprising at a position lower than the supply pipe, a suction pipe for evacuating the treatment liquid, wherein by suctioning the treatment liquid by the suction pipe, the spiral flow is pulled downwards.

4. The filtration apparatus of claim 3, wherein the treatment liquid suctioned by the suction pipe is returned to the filtration container via the supply pipe.

5. The filtration apparatus of claim 3 wherein a tip of the suction pipe extends until a vicinity of a central section in an inner space of the filtration container.

6. The filtration apparatus of claim 1, wherein the supply pipe is arranged such as to be oriented downwards in a vertical portion where the filter layer is formed and a tip opening of the supply pipe is positioned lower than a bottom surface of the filter layer.

7. The filtration apparatus of claim 1, wherein a specific gravity of the floating filter media is smaller than that of the treatment liquid.

8. The filtration apparatus of claim 1, wherein the supply pipe is coupled tangential to a cross section of the filtration container so that the treatment liquid supplied by the supply pipe is caused to rotate.

9. The filtration apparatus of claim 1, wherein washing of the floating filter media is carried out by

causing the treatment liquid to circulate via the suction pipe and the supply pipe while rotating it together with the floating filter media inside the filtration container.

10. The filtration apparatus of claim 3, wherein driving of the suction pipe and supply pipe is carried out by one pump.

11. The filtration apparatus of claim 1, wherein a collector where removables are precipitated and which is separated by a separation member is provided at the bottom of the filtration container.

12. The filtration apparatus of claim 11, wherein the separation member is made of intersecting plates having opening.

13. The filtration apparatus of claim 11, wherein the separation member can be a plates-intersecting structure, oblique plates, a funnel-shaped member or punching metal.

14. The filtration apparatus of claim 3, wherein a first valve, a second valve and a third valve are provided in the supply pipe, suction pipe and discharge pipe, respectively, and a pump is coupled to the supply pipe.

15. The filtration apparatus of claim 14, wherein the treatment liquid is filtered while maintaining the stratified structure of the floating filter media by driving the pump when the first valve, the second valve and the third valve are in an open state.

16. The filtration apparatus of claim 14, wherein the spiral flow sucking in a large part of the floating filter media is generated by driving the pump when the first valve and the second valve are in an open state and the third valve is in a closed state.

17. The filtration apparatus of claim 1, further comprising circulation pipe coupled to the filtration container at a position above the bottom surface of the filter layer, wherein the spiral flow sucking in a large part of the floating filter media is generated by returning the treatment liquid evacuated from the filtration container back inside the filtration container through the circulation pipe.

18. The filtration apparatus of claim 1, further comprising a capture means for capturing the removables and the floating filter media, provided at an entrance of the suction pipe.

19. The filtration apparatus of claim 18, wherein the supply pipe and the suction pipe are connected

by a bypass pipe and the removables deposited in the capture means are scraped off by reverse-flowing the treatment liquid in the suction pipe via the bypass pipe.

20. The filtration apparatus of claim 1, further comprising a static tower for collecting the removables, wherein the static tower and the filtration container are connected by a flow pipe, and the static tower and the supply pipe are connected via a filter media recovery pipe.

21. The filtration apparatus of claim 20, wherein the filter media recovery pipe is narrower than the supply pipe.

22. A filtration method for filtering a treatment liquid by passing the treatment liquid containing removables through a filter layer formed of floating filter media, wherein

by generating a spiral flow in a lower side of the filter layer, a downward force which is stronger than a buoyant force exerted in the floating filter media is applied to the floating filter media of a lowermost layer of the filter layer to separate the floating filter media of the lowermost layer from the filter layer.

23. The filtration method of claim 22, wherein a bottom surface of the filter layer is formed in a funnel shape by the spiral flow.

24. The filtration method of claim 22, wherein the spiral flow is generated by introducing the treatment liquid in a direction following an inner wall of a filtration container housing the filter layer.

25. The filtration method of claim 22, wherein the treatment liquid is pulled downward by sucking the treatment liquid to a position below the filter layer.

26. The filtration method of claim 22, wherein particles having a smaller specific gravity than the treatment liquid are used for the floating filter media.

27. The filtration method of claim 22, wherein the filter layer formed of the floating filter media in an upper portion of a filtration container is formed by housing the floating filter media in the filtration container and supplying the treatment liquid into the filtration container.

28. The filtration method of claim 22, wherein simultaneous with the scraping-off of the floating filter media, the removables are also scraped off and the so scraped-off removables are precipitated

in a collector at the bottom of the filtration container.

29. The filtration method of claim 28, wherein the collector is separated by a separation member and the water flow is suppressed inside the collector.

30. A filtration method for filtering a treatment liquid by passing the treatment liquid containing removables through a filter layer formed of aggregates of floating filter media, wherein

washing of the floating filter media is carried out by generating, inside a filtration container housing the floating filter media, a spiral flow formed of the treatment liquid and sucking in the floating filter media.

31. The filtration method of claim 30, wherein the spiral flow is generated by introducing the treatment liquid in a direction following an inner wall of the filtration container housing the filter layer.

32. The filtration method of claim 30, wherein particles having a smaller specific gravity than the treatment liquid are used for the floating filter media.

33. The filtration method of claim 30, wherein washing of the floating filter media is carried out while causing the treatment liquid to circulate by retrieving the treatment fluid from below a filter surface of the floating filter media and returning the treatment liquid back inside the filtration container at a position above the filter surface.

34. The filtration method of claim 30, wherein washing of the floating filter media is carried out by rubbing the floating filter media amongst themselves.

35. The filtration method of claim 30, wherein by causing the spiral flow to halt, the washed floating filter media return to a stratified state in an upper side of the filtration container, whereas the removables scraped-off from the floating filter media are precipitated at the bottom side of the filtration container.